CLAIMS

1. A fuel cell power system, comprising:

a plurality of modules each enclosing a fuel cell stack and a cooling assembly; and wherein at least one of the modules can be removed from the fuel cell power system, by hand, while the remaining modules continue to operate.

2. A fuel cell power system as claimed in claim 1, and further comprising:

a subrack for receiving and supporting each of the modules in an operational orientation, one to the others.

3. A fuel cell power system as claimed in claim 1, and further comprising:

a subrack for receiving and supporting each of the modules in an operational orientation, one to the others;

a D.C. bus borne by the subrack and electrically coupled with the respective modules when the modules are received in an operable position relative to the subrack; and

a fuel and oxidant manifold borne by the subrack and coupled in fluid flowing relation relative to the respective modules when the modules are operably positioned relative to the subrack.

4. A fuel cell power system as claimed in claim 1, wherein each of the modules further comprise:

a module frame, defining an internal cavity, and wherein the fuel cell stack and cooling assembly are received in the internal cavity of the module frame.

5. A fuel cell power system as claimed in claim 1, and further comprising:

a subrack for receiving each of the modules in an operational orientation, one to the others;

a D.C. bus borne by the subrack and electrically coupled with the respective modules when the modules are positioned in an operable orientation relative to the subrack;

a fuel and oxidant manifold borne by the subrack and coupled in fluid flowing relation relative to the respective modules when the modules are positioned in an operable orientation relative to the subrack, and wherein each of the modules comprise a module frame which matingly cooperates with the subrack, and which further defines an internal cavity; and wherein the fuel cell stack and cooling assembly are received in the internal cavity and the fuel cell stack is electrically coupled to the D.C. bus, and disposed in fluid flowing relationship relative to the fuel and oxidant manifold, when the respective modules are positioned in an operational orientation relative to the subrack.

6. A fuel cell power system as claimed in claim 3, wherein each of the modules further comprise:

a module frame, defining an internal cavity;

an electrical coupler borne by the module frame and which is operable to releasably electrically couple with the D.C. bus when the module frame is disposed in an operable orientation relative to the subrack;

a fluid coupler borne by the module frame and which is operable to releasably couple in fluid flowing relationship with the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack; and wherein the fuel cell stack is mounted in the internal cavity of the module frame and electrically coupled with the electrical coupler, and the D.C. bus, and further is disposed in fluid flowing relation relative to the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack.

7. A fuel cell power system as claimed in claim 6, wherein the fuel cell stack produces heat energy during operation and which collects in the internal cavity of the module frame, and wherein the cooling assembly comprises a fan mounted on the module frame and which facilitates the dissipation of the heat energy from the internal cavity.

8. A fuel cell power system as claimed in claim 7, wherein the fan exhausts the heat energy from the internal cavity of the module frame to an ambient environment.

9. A fuel cell power system as claimed in claim 7, wherein the cooling assembly further comprises:

an air plenum which is positioned in the internal cavity of the module frame, and wherein the fan moves a source of ambient air along same.

10. A fuel cell power system as claimed in claim 9, wherein the cooling assembly further comprises:

a heat exchanger which is borne by the fuel cell stack and which is operable to conduct heat energy away from the fuel cell stack, and wherein the heat exchanger is disposed in heat transferring relation relative to the air plenum.

11. A fuel cell power system as claimed in claim 9, and wherein the cooling assembly further comprises:

a coolant pump mounted in the internal cavity of the module frame and which is coupled in fluid flowing relation relative to the fuel cell stack, the coolant pump circulating a source of coolant through the fuel cell stack to remove heat energy generated by the fuel cell stack during operation; and

a heat exchanger coupled in heat exchanging relation relative to the coolant pump, the heat exchanger disposed in heat transferring relation relative to the air plenum.

12. A fuel cell power system as claimed in 3, wherein each of the modules further comprise:

a module frame, defining an internal cavity;

an electrical coupler borne by the module frame and which releasably electrically couples with the D.C. bus when the module frame is disposed in an operable orientation relative to the subrack;

a fluid coupler borne by the module frame and which releasably couples in fluid flowing relationship with the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack; and wherein the fuel cell stack is mounted in the internal cavity of the module frame and is further electrically coupled with both the electrical coupler and the D.C. bus, and disposed in fluid flowing relation relative to the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack, and wherein the fuel cell stack produces heat energy during operation; and wherein the cooling assembly is borne by the module frame and dissipates the heat energy generated by the fuel cell stack during operation; and

a controller which is electrically coupled with both the fuel cell stack and the cooling assembly to control the operation of each.

13. A fuel cell power system as claimed in claim 12, wherein the cooling assembly further comprises:

an air plenum borne by the module frame and mounted in the internal cavity thereof, and which directs a source of ambient air through the internal cavity of the module frame; and

a fan assembly borne by the module frame and which moves the ambient air along the air plenum to dissipate the heat energy generated

by the fuel cell stack during operation and which is present in the internal cavity of the module frame.

14. A fuel cell power system as claimed in claim 13, wherein the cooling assembly further comprises:

a heat exchanger which is borne by the fuel cell stack and which conducts heat energy away from the fuel cell stack while it is in operation, and wherein the heat exchanger is disposed in heat transferring relation relative to the air plenum.

15. A fuel cell power system as claimed in claim 13, and wherein the cooling assembly further comprises:

a coolant pump mounted in the internal cavity of the module frame and which is coupled in fluid flowing relation relative to the fuel cell stack, and which circulates a source of coolant through the fuel cell stack to remove heat energy generated by the fuel cell stack; and

a heat exchanger coupled in heat exchanging relation relative to the coolant pump, and disposed in heat transferring relation relative to the air plenum.

16. A fuel cell power system, comprising:

an enclosure defining an internal space;

a subrack movably mounted on the enclosure and operable to be received in the internal space of the enclosure; and

operational, and wherein each subrack is releasably coupled to each of the electrical conduit, fuel and oxidant conduit, and controller conduit.

20. A fuel cell power system as claimed in claim 17, wherein each subrack further comprises:

a D.C. bus borne by the subrack and electrically coupled with the respective modules when each of the modules are received in an operable position relative to the subrack; and

a fuel and oxidant manifold borne by the subrack and coupled in fluid flowing relation relative to the respective modules when the respective modules are operably positioned relative to the subrack.

21. A fuel cell power system as claimed in claim 18, wherein each of the modules further comprise:

a module frame which defines an internal cavity; and wherein the fuel cell stack and the cooling assembly are received in the internal cavity of the module frame, and wherein the respective module frames matingly cooperate with the subrack, and wherein each module frame is both electrically coupled to the D.C. bus, and disposed in fluid flowing relationship relative to the fuel and oxidant manifold, when the respective modules are positioned in an operational orientation relative to the subrack.

22. A fuel cell power system as claimed in claim 21, wherein each of the module frames further comprise:

an electrical coupler borne by the respective module frames and which is operable to releasably electrically couple with the D.C. bus when each of the module frames are disposed in an operable orientation relative to the subrack; and

a fluid coupler borne by the respective module frames and which is operable to releasably couple in fluid flowing relationship with the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack.

23. A fuel cell power system as claimed in claim 22, wherein the fuel cell stack produces heat energy during operation and which collects in the internal cavity of the module frame, and wherein the cooling assembly comprises a fan which is mounted on the module frame and which facilitates the dissipation of the heat energy from the internal cavity.

24. A fuel cell power system as claimed in claim 22, wherein the cooling assembly further comprises:

an air plenum which is positioned in the internal cavity of the module frame, and wherein the fan moves a source of ambient air along same.

25. A fuel cell power system as claimed in claim 24, wherein the cooling assembly further comprises:

a heat exchanger which is borne by the fuel stack and which is operable to conduct heat energy away from the fuel cell stack, and wherein

the heat exchanger is disposed in heat transferring relation relative to the air plenum.

26. A fuel cell power system as claimed in claim 24, and wherein the cooling assembly further comprises:

a coolant pump mounted in the internal cavity of the module frame and which is coupled in fluid flowing relation relative to the fuel cell stack, and which circulates a source of coolant through the fuel cell stack to remove heat energy generated by the fuel cell stack; and

a heat exchanger coupled in heat exchanging relation relative to the coolant pump, and which is disposed in heat transferring relation relative to the air plenum.

27. A fuel cell power system as claimed in claim 23, wherein each of the modules further comprise:

a controller which is electrically coupled with both the fuel cell stack and the cooling assembly to control the operation of each.

28. A fuel cell power module, comprising:

a module frame having an internal cavity;

a fuel cell stack mounted in the internal cavity of the module frame;

a controller which is electrically coupled to the fuel cell stack; and

a cooling assembly borne by the module frame and which is electrically coupled with the controller for dissipating heat energy generated while the fuel cell stack is operational.

29. A fuel cell power module as claimed in claim 28, wherein the module frame is defined by an exterior wall, and further has opposite first and second ends, and wherein a control panel is borne by the first end of the exterior wall and is electrically coupled with the controller; and wherein the controller is mounted in the internal cavity of the module frame.

30. A fuel cell power module as claimed in claim 29, wherein an electrical coupler is mounted on the exterior wall at the second end of the module frame and further electrically coupled to the fuel cell stack, and wherein a fluid coupler for delivering a fuel supply and an oxidant supply to the fuel cell stack is mounted on the second end of the module frame and is coupled in fluid flowing relation relative to the fuel cell stack, and wherein a data coupler is mounted on the second end of the module frame and is electrically coupled with the controller.

31. A fuel cell power module as claimed in claim 30, wherein the cooling assembly further comprises:

a fan mounted on the first end of the module frame and which exhausts heat which has collected in the internal cavity of the module frame to ambient.

32. A fuel cell power module as claimed in claim 30, wherein the cooling assembly further comprises:

an air plenum borne by, and which extends between, the first and second ends of the module frame, and which further is coupled in fluid flowing relation to ambient; and

a fan mounted in the internal cavity of the module frame and coupled to the air plenum to facilitate the movement of ambient air between the opposite ends of the module frame.

33. A fuel cell power module as claimed in claim 32, wherein the cooling assembly further comprises:

a heat exchanger mounted on the fuel cell stack, and which conducts heat energy away from fuel cell stack during operation, and wherein at least a portion of the heat exchanger is located within the air plenum.

34. A fuel cell power module as claimed in claim 32, wherein the cooling assembly further comprises:

a coolant pump for circulation of a coolant and which is coupled in fluid flowing relation relative to the fuel cell stack; and

a heat exchanger mounted on the module frame, and wherein a portion of the heat exchanger is located within the air plenum, and is further coupled in heat exchanging relation relative to the coolant pump.

35. A fuel cell power module as claimed in claim 31, wherein the fuel cell module frame matingly couples with a subrack which supports the fuel cell module in an operable orientation.

37. A fuel cell power module as claimed in claim 35, wherein the subrack further comprises:

a D.C. bus borne by the subrack and electrically coupled with the fuel cell power module, by way of the electrical coupler, when the fuel cell power module is received in an operable position relative to the subrack; and

a fuel and oxidant manifold borne by the subrack and coupled in fluid flowing relation relative to the fuel cell power module when the module is operably positioned relative to the subrack.

38. A fuel cell power module as claimed in claim 37, wherein the subrack supporting the fuel cell module holds a plurality of fuel cell modules to form a fuel cell power system, and wherein the respective fuel cell modules may be removed from the subrack while the remaining fuel cell modules continue to operate.

39. A fuel cell power module as claimed in claim 38, and further comprising:

an enclosure having a cavity and which matingly and operably receives the subrack, and wherein the enclosure mounts multiple subracks, and wherein individual subracks may be removed from the enclosure while the remaining subracks remain operational.

40. A fuel cell power system, comprising:

a subrack;

a D.C. bus mounted on the subrack;

a fuel and oxidant manifold borne by the subrack;

a module frame, defining an internal cavity and which is matingly received and supported in an operable orientation on the subrack;

an electrical coupler borne by the module frame and which releasably electrically couples with the D.C. bus when the module frame is disposed in an operable orientation relative to the subrack;

a fluid coupler borne by the module frame and which releasably couples in fluid flowing relationship with the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack;

a fuel cell stack mounted in the internal cavity of the module frame and which is electrically coupled with both the electrical coupler and the D.C. bus, and further disposed in fluid flowing relation relative to the fuel and oxidant manifold when the module frame is disposed in an operable orientation relative to the subrack, and wherein the fuel cell stack produces heat energy during operation;

a cooling assembly borne by the module frame and which dissipates the heat energy generated by the fuel cell stack during operation; and

a controller which is electrically coupled with both the fuel cell stack and the cooling assembly to control the operation of each.

41. A fuel cell power system as claimed in claim 40, wherein the cooling assembly further comprises:

an air plenum borne by the module frame, and which further is coupled in fluid flowing relation to ambient; and

a fan mounted in the internal cavity of the module frame and coupled to the air plenum to facilitate the movement of ambient air along the air plenum.

42. A fuel cell power system as claimed in claim 41, wherein the cooling assembly further comprises:

a heat exchanger mounted on the fuel cell stack and which conducts heat energy away from fuel cell stack during operation, and wherein at least a portion of the heat exchanger is located within the air plenum.

43. A fuel cell power system as claimed in claim 41, wherein the cooling assembly further comprises:

a coolant pump for circulation of a coolant coupled in fluid flowing relation relative to the fuel cell stack; and

a heat exchanger mounted in the module frame, and wherein a portion of the heat exchanger is located within the air plenum, and is further coupled in heat exchanging relation relative to the coolant pump.

44. A fuel cell power system as claimed in claim 40, wherein the subrack supporting the fuel cell module supports a plurality of fuel cell modules, and wherein the respective fuel cell modules may be removed from the subrack while the remaining fuel cell modules continue to operate.

45. A fuel cell power system as claimed in claim 40, and further comprising:

an enclosure defining a cavity and which matingly and operably receives and supports the subrack, and wherein the enclosure releasably mounts multiple subracks, and wherein individual subracks can be removed from the enclosure while the remaining subracks remain operational.

46. A fuel cell power system, comprising:

an enclosure having a cavity and which has a data conduit; a power conduit; and a fuel delivery conduit mounted on same;

multiple subracks releasably borne by the enclosure and supported in an operable orientation in the cavity;

a D.C. bus mounted on each of the subracks and which is electrically coupled to the power conduit when the respective subracks are received in the cavity of the enclosure;

a fuel manifold mounted on each of the subracks and which is coupled in fluid flowing relation relative to the fuel delivery conduit when the respective subracks are received in the cavity of the enclosure;

multiple fuel cell modules operably received and supported by the respective subracks, and wherein each of the fuel cell modules have a module frame, defining an internal cavity, and which is matingly received and supported in an operable orientation on the respective subracks;

an electrical coupler borne by each of the module frames and which releasably electrically couples with the D.C. bus when the individual module

frames are disposed in an operable orientation relative to one of the subracks;

a fluid coupler mounted on each of the module frames and which releasably couples in fluid flowing relationship with the fuel manifold when the module frame is disposed in an operable orientation relative to one of the subracks;

a fuel cell stack mounted in the internal cavity of each of the module frames and which is electrically coupled with both the electrical coupler and the D.C. bus, and further disposed in fluid flowing relation relative to the fuel manifold when the module frame is disposed in an operable orientation relative to one of the subracks, and wherein each fuel cell stack produces heat energy during operation;

a cooling assembly borne by each of the module frames and which dissipates the heat energy generated by each of the fuel cell stacks during operation; and

a controller which is electrically coupled with both the fuel cell stack and the cooling assembly of that fuel cell module to control the operation of each, and wherein the controller is coupled in signal transmitting and receiving relation relative to the data conduit, and wherein individual subracks and individual fuel cell modules may be operably removed from the fuel cell power system while the remaining fuel cell modules and subracks remain operational.